

# REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY)

2. REPORT TYPE

Technical Paper

3. DATES COVERED (From - To)

4. TITLE AND SUBTITLE

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

5d. PROJECT NUMBER

2308

5e. TASK NUMBER

M19B

5f. WORK UNIT NUMBER

346 058

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

8. PERFORMING ORGANIZATION REPORT

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)

Air Force Research Laboratory (AFMC)

AFRL/PRS

5 Pollux Drive

Edwards AFB CA 93524-7048

11. SPONSOR/MONITOR'S NUMBER(S)

Please see attached

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

20030204 071

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:

17. LIMITATION OF ABSTRACT

18. NUMBER OF PAGES

19a. NAME OF RESPONSIBLE PERSON

Leilani Richardson

a. REPORT

b. ABSTRACT

c. THIS PAGE

Unclassified

Unclassified

Unclassified

A

19b. TELEPHONE NUMBER

(include area code)

(661) 275-5015

23 APR 1981

MEMORANDUM FOR PRS (Contractor Publication)

FROM: PROI (STINFO)

13 Apr 2001

SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-TP-2001-085**  
Ghanshyam L. Vaghjiani, "Reaction of CH<sub>2</sub> with O-atoms: A Source for CO-Chemiluminescence"

**2001 Molecular Dynamics Contractor's Review**  
**(Irvine, CA, 21-23 May 2001) (Deadline: 30 Apr 01 )**

**(Statement A)**

1. This request has been reviewed by the Foreign Disclosure Office for: a.) appropriateness of distribution statement, b.) military/national critical technology, c.) export controls or distribution restrictions, d.) appropriateness for release to a foreign nation, and e.) technical sensitivity and/or economic sensitivity.

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

2. This request has been reviewed by the Public Affairs Office for: a.) appropriateness for public release and/or b) possible higher headquarters review.

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

3. This request has been reviewed by the STINFO for: a.) changes if approved as amended, b) appropriateness of references, if applicable; and c.) format and completion of meeting clearance form if required

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

4. This request has been reviewed by PR for: a.) technical accuracy, b.) appropriateness for audience, c.) appropriateness of distribution statement, d.) technical sensitivity and economic sensitivity, e.) military/national critical technology, and f.) data rights and patentability

Comments: \_\_\_\_\_  
\_\_\_\_\_

APPROVED/APPROVED AS AMENDED/DISAPPROVED

\_\_\_\_\_  
PHILIP A. KESSEL Date  
Technical Advisor  
Space and Missile Propulsion Division

## Reaction of CH<sub>2</sub> With O-atoms: A Source for CO-Chemiluminescence

Ghanshyam L. Vaghjiani  
ERC  
Air Force Research Laboratory, AFRL/PRSA  
10 E Saturn Blvd  
Edwards AFB, CA 93524

Email: ghanshyam.vaghjiani@edwards.af.mil  
Tel: 661 275 5657  
Fax: 661 275 6245

The interactions of carbonaceous combustion species in rocket plumes with the atmosphere are thought to play an important role in the production of ultraviolet, visible, and infrared radiation signatures at high altitudes. A detailed understanding of the pertinent chemical reactions that produce the electronically excited species, and of the competing quenching reactions that remove the internal energy in radiation-less processes is needed to accurately calculate plume spectral signatures and absolute radiances (in the short wavelength region), and their temporal/spatial evolution in the high atmosphere. To facilitate these efforts, we are currently carrying out laboratory investigations to elucidate the reaction mechanism(s) in the oxidation of CH, CH<sub>2</sub>, C<sub>2</sub>H, and C<sub>2</sub>O with O-atoms and O<sub>2</sub>. Sufficient exothermicity in CH, CH<sub>2</sub>, and C<sub>2</sub>H reactions (except C<sub>2</sub>H + O) is available to produce CO in one or more of the triplet states (a, a', and d). Even more reaction enthalpy is available in C<sub>2</sub>O reaction(s) to produce higher excited states of CO (e, A, I, and D). Other excited species such as CH(A<sup>2</sup>Δ) in C<sub>2</sub>H plus O or O<sub>2</sub>, and OH(A<sup>2</sup>Σ<sup>+</sup>) in CH + O<sub>2</sub> reactions are also possible. CO-uv chemiluminescence has previously been identified in C<sub>2</sub>H + O<sub>2</sub> reaction and both CO-uv and CO-vuv in the C<sub>2</sub>O + O reaction. However, no information is available on the product branching ratios of the excited CO states responsible for the emission. Estimates of the branching ratio of CH(A<sup>2</sup>Δ) formation in the reactions of C<sub>2</sub>H with O and O<sub>2</sub> can be found in the literature. To our knowledge, triplet CO formation in CH and CH<sub>2</sub> reactions has not yet been positively identified. Fast discharge-flow tube and pulsed-laser photolysis methods have been employed in this work to study the reaction kinetics and chemiluminescence in these reactions. The experimental approach and results of these studies will be presented.